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ABSTRACT

This report summarizes findings and recommendations from the Road Ahead Program (1995-1997) of the National Foundation for the Improvement of Education (NFIE), a nonprofit foundation of the National Education Association and funded by Bill Gates, cofounder and CEO of Microsoft Corporation. Twenty-two sites in 15 states were selected by the NFIE. The essential elements of the Road Ahead included: (1) school-community partnerships, (2) a $30,000 grant to each site, (3) three conferences, (4) a teacher mentor assigned to each site, (5) an online network, and (6) Microsoft software. Evaluation surveys focused on two fundamental questions: (1) To what extent were sites able to implement their programs and achieve their explicit objectives? (2) What effects did the Road Ahead model have on the four areas of concern--student learning, professional development, technology use, and systemic change? Findings are discussed in this report in terms of each of these four areas. Factors that helped and hindered the program, program support, and recommendation are also discussed. (AEF)

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Connected Learning Communities:
Findings from The Road Ahead Program 1995-1997

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International Society for Technology in Education

Adapted from a report to the
National Foundation for the Improvement of Education
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Introduction

This report summarizes findings and recommendations from The Road Ahead Program (1995-1997) of the National Foundation for the Improvement of Education (NFIE), a nonprofit foundation of the National Education Association. The Road Ahead was funded by Bill Gates, cofounder and CEO of Microsoft Corporation, with proceeds from his book by the same name (Gates, 1995).

The essential elements of The Road Ahead included:

- School–community partnerships developed by five-member teams that included a public school teacher as team leader, a school administrator, a representative from an after-school program, and a representative from a community-based organization. The fifth member could be from any of these groups, support personnel, or higher education. Three hundred and forty-eight proposals were submitted to NFIE. Twenty-two sites in 15 states were selected in July 1995.
- A $30,000 grant to each site, spread over two years ($20,000 in Year 1) to help sites "design and implement collaborative, student-centered activities that demonstrate how teaching and learning are facilitated by multimedia and telecommunications technologies" and "to foster students' ability and confidence to use information technologies in powerful ways in both formal and informal learning settings" (NFIE, 1995).
- Three conferences: A Capacity-Building Workshop in September 1995 in Washington, DC; the NFIE Summer Institute in July 1996 in Seattle, Washington; and The Road Ahead Summer Conference in June 1997 in Seattle. All three conferences included technical computer training and presentations by educational leaders. The first conference emphasized revision of team plans. The second concentrated on professional development in technology and curriculum. The third included additional training, but also featured sharing of results and planning for the future.
- A teacher mentor assigned to each site. The mentor had background relevant to the site's program, but did not live or work in the same region as the site.
- An online network to facilitate communications among mentors, other sites, and the NFIE office.

- A large amount of Microsoft software (primarily multimedia CD titles) and two Compaq computers.

The overall program goals for the school–community partnerships, as listed in the original Program Guidelines (NFIE, 1995) were:

- to design and implement collaborative, student-centered activities that demonstrate how teaching and learning are facilitated by multimedia and telecommunications technologies;
- to foster student's ability and confidence to use information technologies in powerful ways in both formal and informal learning settings;
- to assess the effects of participation in technology-infused learning environments on students, teachers and other educators, and staff from community-based organizations; and
- to share program findings, replicate successful practices, and offer policy recommendations to promote widespread provision and use of multimedia and telecommunications technologies for effective student learning.

NFIE selected sites with a wide variety of technology experience, ranging from an elementary school in which students were experiencing their first computer access to a high school in which students were creating commercial-quality multimedia. In pursuing the general goals above, the 22 sites developed a variety of objectives and activities for students, teachers, organization staff, and other adults in their communities. NFIE asked the evaluation contractor, the International Society for Technology in Education (ISTE), to focus on four areas of inquiry in assessing the implementation and outcomes of The Road Ahead:

- Student learning: what knowledge and skills students acquired as a result of participation in the program.
- Professional development: how educators increased their skills and leadership abilities through The Road Ahead.
- Technology use: how the schools and community organizations employed computers and other technologies.
- Systemic change: fundamental structural changes that supported implementation and institutionalization of program activities.

Methodology

The fundamental questions we hoped to answer in our evaluation of The Road Ahead were:

- To what extent were sites able to implement their programs and achieve their explicit objectives?
- What effects did The Road Ahead model have on the four areas of concern—student learning, professional development, technology use, and systemic change?

This program's combination of grants, intense professional development, mentoring at a distance, school–community partnerships, and technology was unique. Furthermore, these components were manifest in different ways in each community. Sites had a variety of expected outcomes, ranging from "hard" quantitative achievement measures to "soft" affective changes such as self-concept. For these reasons, we consider The Road Ahead to be a pilot rather than a demonstration. We sought to identify any and all effects that sites could report. In the recommendations section of this document, we suggest how our findings may be used to refine the model and to develop independent variables that can be used for comparisons between programs and experimental manipulation of program components.

We collected a variety of types of data. Surveys distributed to site teams in May 1996 and April 1997 asked about site goals, accomplishments, problems, and use of resources. The 1996 and 1997 surveys were very similar, involving mostly short narrative responses, with some checklists and rating scales. The reporting forms in the 1997 version were expanded to elicit more detailed answers. A secondary survey regarding use of the online network was also bundled with the 1997 form.

The reliability of self-report data is always questionable, and so the survey data was compared with a variety of other sources, including surveys and interviews with the site mentors, records of online discussions, and other information from the sites (grant proposals, Web pages, and conference presentations.)

Structured interviews were conducted with teams and mentors at the 1996 and 1997 summer conferences in Seattle, Washington. Our intention was to collect all surveys each year prior to the interviews, and to use the face-to-face sessions to check and elaborate on the survey responses. In practice, most teachers had difficulty completing the surveys while school was in session, and most of the interviews were conducted either without the survey in hand, or without a complete analysis of the responses. In 1997, we provided the survey forms three weeks earlier in the spring, but this made no difference in the response time: The teachers needed the summer break period to work on the evaluation materials. As a result, we needed to contact most sites at least once by e-mail or phone with follow-up questions. All sites completed the survey in the first year. Nineteen sites completed the final survey.

Evaluators visited nine of the sites during the period of the grant. Two of these visits were informal, in which an evaluator accompanied NFIE staff as an observer. Seven of the visits were more structured; pairs of evaluators visited a site to document activities and conditions in The Road Ahead learning environments and to interview various stakeholders in the school and community.

Site profiles, based on the surveys, interviews, and (when available) site visits, were written up and distributed to the sites so that teams could comment and propose revisions. In addition, a brief survey was mailed to all sites in November of 1997, during the first school year after the end of the grant. For each site, we listed the team's predictions of what their program would look like in 1997–1998, and

asked for an update on what activities were ongoing or discontinued. Twelve of the sites returned this survey.

Findings

Student Learning

The Road Ahead teams reported student learning gains in a variety of ways, including grades, test scores, teacher or other adult observation, and completion of projects. The number of students affected at the different sites varied considerably. Even within sites, some activities sponsored by the grant affected all students in a school, while others affected only certain classrooms or groups.

Student use of technology

In both years, increased technology use was the one student learning outcome common to all sites. Students developed hypermedia reports, created digital graphics, authored Web pages, searched CD-ROM databases, videoconferenced, gathered data using science probes, used tool software such as word processors to complete assignments, and delivered computer-based presentations. Some sites did not involve as many students as they had hoped or were not able to use all the technologies they had hoped, but these were issues of access and organization rather than a problem of student learning *per se*.

Students assuming roles as teachers or leaders

This is one of the most striking outcomes of The Road Ahead. In 1995-96, seven of 22 sites reported students taking on the roles of teachers, either of peers or of adults. In the second year of the program, 15 sites reported this outcome. The effect is notable because only five sites went into the program with this as an explicit goal. The effect is partly attributable to the 1996 conference in Seattle, which included presentations of successful student-managed technology programs. Some of these examples were explicit student teaching roles (e.g., students teaching public Recreation Department classes to adults). In other cases, teachers reported that students who participated in The Road Ahead activities (such as after-school computer clubs) naturally assumed roles as peer mentors when they took their technology skills back to regular classrooms.

Increased motivation

In the first year of the program, most sites (16 of 22) reported increases in student motivation or independence as learners. Not as many (seven of 19) reported this outcome in the second year, although only two sites actually mentioned problems with motivation. This suggests that increases in student engagement or motivation were greatest as the new technology and activities were introduced. Students did not drop out or become bored with activities, but already-engaged students did not

necessarily become more motivated and independent (there are practical limits to how much independence schools will grant and students can assume). With the two sites reporting motivational problems, in one case, the difficulty was related to lack of focus and progress on a core project; in the other, the program suffered from the loss of adult supervision for an after-school activity.

Achievement in core subjects

In comparison to the first year, the second year provided more evidence of increased student academic achievement. Several sites noted that the first year was, of necessity devoted to training for teachers before the staff could bring their new technology skills to bear in classrooms and after-school programs. Of the eight sites that reported increased achievement in core subjects, three could point to increased test scores; the others based their assessment on grades or student products.

Higher-order thinking skills

Eight sites listed thinking skills among their goals, and four of these plus one other site indicated that students successfully completed problem-solving activities. There were no formal tests of thinking ability in the program; teams presented successful completion of the projects as evidence of intellectual progress. This is a common educational strategy (ISTE, 1996), although there can obviously be great variation in the demands of individual projects. The teams that specifically mentioned this outcome were all secondary schools, which suggests that it may be easier to elicit and observe or infer higher-order thinking in the work of older students. High school students at one site set up a multimedia lab in a middle school; middle school students at two other sites worked in teams to carry out environmental studies; other middle school activities included browsing and rating Web sites and using technology to conduct a schoolwide mock election.

Professional Development

On the average, teams devoted about 36% of their budgets to professional development and staffing (substitutes) to enable professional development. This is in keeping with the rule of thumb that 30% of a computer technology budget should be devoted to professional development (Panel on Educational Technology, 1997). Sites used this money to send members to regional conferences, to offer graduate courses to school faculty and staff, to bring in experts, and to pay stipends to their own staff to provide and attend workshops.

However, this percentage of each $30,000 site budget only represents the training arranged by the site. Each team also benefited from the three conferences, which were provided by NFIE. These amounted to 19 days of training and workshops over the course of two school years. This resource alone is roughly equivalent to a three-semester-hour graduate course at a university (indeed, a number of participants received graduate credit for attending the conferences). Some sites had additional training provided by their mentors. In other words, The Road Ahead involved a

substantial addition of professional-development resources to the schools and community agencies involved.

Professional use of technology

As with student learning, technology skill was the most common professional-development objective, and all the surveyed sites (and two of the sites that did not complete surveys) reported increases in the skill of school and/or community staff. Clearly, the professional-development activities offered through The Road Ahead were effective in this regard. Evaluation forms completed by participants in the 1996 and 1997 summer conferences gave high marks to the technology sessions that made up four-day strands at each event. Although this training was concentrated into a few days and was out of the school context, the quality and intensity of the experience, coupled with the fact that entire teams participated, was apparently sufficient to enable The Road Ahead teams to take the learning back and apply it in their schools and community agencies.

Teachers teaching teachers

The dominant model of professional development at the sites was teachers teaching teachers, an approach supported in previous research (Joyce & Showers, 1988; NFIE, 1996). Staff training took place in the form of staff-run inservices, workshops, or informal help sessions. Fourteen of the 22 sites mentioned their reliance on this approach.

Technology Use

Network access and use

Sixteen sites reported that teacher use of networking had increased by the end of the grant period. Twelve sites reported increased student network use. According to the Online Use Survey, network applications such as e-mail and the Web were more accessible to teachers than for students. The teachers were more likely to have their own school computers or home accounts, and student access was sometimes limited by school security restrictions. Several community partners began using computers for communication with the school, for internal use, or to provide community access. Most of this hardware and network access will remain after The Road Ahead.

Software applications

The types of computer uses introduced into The Road Ahead sites were diverse. They included desktop publishing, CD-ROM and Internet-based research, e-mail, and videoconferencing. Multimedia and hypermedia played a prominent role. Nine of the surveyed sites reported that students were able to create technology-based products such as HyperStudio stacks and Web pages. (HyperStudio was also used in two other sites that did not complete the 1997 survey.) Use of the Web as a

publishing medium was somewhat higher than was anticipated in the original proposals. Several teams brought up Web pages for the first time as part of The Road Ahead. Reflecting a trend in the multimedia industry, some student publishing projects changed during the program from CD-ROM to the Web.

Portable computers

Portable computers were used at eight sites to increase access to scarce technology and to collect field data in a machine-editable form. Computer carts were used in schools to bring multimedia computers to classrooms, to take student files from non-networked classrooms to modem-equipped computers, and to transport large multimedia files from one school to another. Laptop or notebook computers were used by students to record readings from scientific probes, to take notes during field trips, and to pass around in class to edit compositions.

Increased access

One change encouraged or provided by The Road Ahead was increased access to technology already in place (mentioned by five sites in the second year of the program). This came about by direct funding of the after-school program (essentially lengthening the school day for participating students), or by rescheduling of time to make better use of facilities during existing school hours. Inadequate technology was listed as an impediment to the programs by 10 sites in 1997.

Integration

Thirteen of 19 sites completing the Year-2 survey reported that technology had been increasingly integrated into curriculum. Probably all sites could claim some level of integration, in terms using technology to acquire or communicate information that students were studying in school, as opposed to learning technology as a subject in itself.

Types of learning activities where technology was essential included information gathering at a distance through e-mail and videoconferencing, use of scientific probeware, and authentic publication of student work through optical media or the World Wide Web. These are what Moursund (1997) describes as "second-order" effects. The technology is being used to accomplish tasks or assume roles that would not be possible without computer tools. However, most activities that we witnessed or that were reported to us used technology for "first-order" tasks such as writing text, recording data, and assembling in-class reports that could have been accomplished with other media.

The level of integration seems to be partly a matter of experience and training. Most Web pages and HyperStudio stacks we viewed did not take advantage of hypertext linking to assemble and relate a wide range of information. They were essentially linear slide shows. However, more experienced students (e.g., second-year multimedia authors) and participants in more intensive training programs (e.g., a summer Web class) produced hypertext products that tended to be more

complex than the stacks and Web pages of other students in the same schools. This suggests that the movement from first-order to second-order use of technology is a process and that sites that continue to pursue their technology programs will integrate more of the unique advantages of computer tools in the future.

At any level of technology use, integration also sometimes happens moment-by-teachable-moment when alert teachers use technology-based activities to elicit or apply fundamental skills. For instance, we watched an assistant principal helping elementary students create a Web-page graphic of 100 pennies. When the students lost track of how many penny images they had pasted into their workspace, they began to count them one by one, The administrator pointed out that the pennies were in columns and rows, and used what had been a straightforward computer task to review multiplication strategies. In this case, the curriculum was integrated into the technology.

Systemic Change

"Systemic" can refer to changes that are fundamental (as in changing the roles of teachers and learners), structural (as in a change to block scheduling), or that affect people systemwide (as in adoption of a school-improvement plan). We counted all three kinds of examples in evaluating systemic changes in The Road Ahead sites. The surveys asked teams to list examples of systemic changes under categories of Student/Teacher/Organizational Roles, Budget, Time, and Planning. Our concern was identifying actions that would promote continuation of the learning activities begun under the grant. We paid particular attention to the second-year survey responses, on the assumption that they represented the better prediction of future events.

Changes in roles

The largest number of changes reported by the largest number of sites was in the area of teacher, student, and community-partner roles. All sites had increased contact between community partners and schools—this was a requirement of the grant. Most sites that returned surveys reported increased coordination of programs, and two of the sites that did not return surveys indicated in interviews and other reports that these kinds of changes had taken place. Only one site had its major partnership disappear, and even in that case, the community organization is still involved with other educational programs.

Five sites reported that the school had become a community resource. In an interesting reversal at one site, the library became a teacher-training resource that provided required continuing education credits not available through the district.

Eight sites reported that their teachers moved to a more facilitative (as opposed to didactic) mode of instruction. Another change for teachers, reported by six sites, was the emergence of building-level personnel as district leaders. In interviews and presentations at the Seattle conference in 1997, individual team members from

three different sites described how The Road Ahead had drawn them onto a national stage through travel and conference presentations.

We believe the emergence of school children as peer and adult teachers, described earlier as a student learning outcome, deserves to be mentioned again here as a systemic (in the sense of fundamental) change in the teaching and learning process. The student-as-teacher is a common component of project-based, cooperative, and constructivist learning.

Funding

As the profiles in the preceding section indicate, some of the activities specific to The Road Ahead will have to be scaled back with the end of grant funding. Three sites will charge user fees to support some activities. In reporting on budget changes, four sites said part or all of their programs will be picked up by other school or district funding. Six sites felt technology had become a higher priority in their school budgets, and two of those specifically mentioned increased technical support. One school district passed a tax measure. However, in most cases, there were no radical budget changes perpetuating The Road Ahead; rather, teams sought to cover ongoing activities under other initiatives.

Time

In any informal discussion of The Road Ahead with participants, one topic that invariably came up was the large amount of time required to undertake a new initiative. Inadequate time and awkward scheduling have been identified for many years as problems for teachers. Very little systemic change was reported in this regard during The Road Ahead; the issues were probably too complex to be addressed in this program. Nevertheless, a smaller percentage of sites identified time a major hindering factor in 1997, so some successful adaptations were made. Among the 16 teams that commented on time issues in the 1997 survey, the main strategy for coping with time issues was for individuals to donate extra hours. Six sites reported that they were able to obtain additional time for planning or training within the work day, while two sites reported that after-hours meetings were the only way to avoid schedule conflicts between the school and community partner. Another strategy in this regard was using e-mail instead of face-to-face meetings, but only two sites reported this as a systemic change. Only one site reported that the school was actively pursuing a restructured schedule.

Planning

Only seven sites made any comments on the planning section of the 1997 survey. Five of these mentioned increased planning activities for technology or curriculum, two mentioned that The Road Ahead had fostered additional grant applications. In their proposals and other documents, 14 of the sites report operating under formal district or school technology plans or a technology planning process. No sites listed the lack of a technology plan as a major hindering factor in carrying out their

programs, although three sites mentioned the need for a plan during interviews. Although the two sites that entered the program with the least numbers of computers did not have technology plans, there was otherwise no particular relationship between presence of a technology plan and relative success within The Road Ahead.

All this is notable as a *lack* of findings—notable in that the helping and hindering forces in the next section—in particular, time, technology access, and site stability—are factors that might be affected by having an overall direction provided by a long-range plan.

Factors that helped and hindered programs

In both years of the program, 19 sites provided lists of main factors that they felt helped them achieve their goals, or that presented challenges to be overcome. (A different set of three sites did not respond to the questions each year.) The most frequently mentioned factors were time, technology, teamwork, and site stability.

Time

Scheduling problems and lack of time were listed as impediments in both 1996 and 1997, although by a smaller number in 1997 (12 sites versus 16 in 1996). If time issues were not solved, at least sites were learning to cope. Time was primarily mentioned as a barrier to team planning by adults, rather than as a limitation on student activities. (However, there were two schools that dropped out of partnerships partly because of student scheduling conflicts.)

Flexibility in time and work assignments was the most common helping factor, listed by 10 sites in 1997. Only four sites had mentioned this benefit in 1996. However, the effect of flexible scheduling may not be as great as the overall numbers suggest: Half the sites that reported scheduling flexibility as a helping factor still reported time to be a serious concern in 1997. In other words, flexible scheduling helps make better use of time, but does not eliminate the issue.

Technology

The overall role of technology as an important helping or hindering factor remained about the same in each year of the program. In both 1996 and 1997, 10 sites listed technology problems or lack of technology as hindering factors. In both years, four sites listed new or better technology as an important helping factor. These were not necessarily the same sites each year: Some sites apparently solved their problems, while others had new problems arise. For instance, one site achieved a higher level of computer use, but then found its limited facilities were under pressure to accommodate demand. The adequacy of technology is always relative to program needs. The high school site with the most technologically advanced computer workstations in The Road Ahead is in constant need of updated hardware and software for its students' leading-edge digital imaging projects.

In a related finding, a lack of technical knowledge and/or technical support was listed by seven teams in the first year of the program. Only three sites—different sites—reported these hindrances in the second year. Technical knowledge and support have increased in The Road Ahead through the hiring of new technology coordinators (two sites), the reassignment of classroom teachers to learn and teach technology (two sites), new technology planning efforts (two sites), and the emergence of students as teachers (14 sites; see above). However, the obvious program-wide influence on technology knowledge is the greater experience with technology, including intense four-day training sessions at the 1996 and 1997 conferences.

To put technology access and support into perspective, recent national surveys indicate that for most schools in the United States, lack of infrastructure is still a serious problem (Panel on Educational Technology, 1997). In that light, the fact that only half of The Road Ahead sites listed inadequate technology as a major challenge for their programs, and the fact that most sites solved (or at least coped) with their support issues suggests that these schools are in a substantially stronger technology position than most.

Shared vision and commitment; teamwork

In both 1996 and 1997, sites commented on the value of team members sharing common goals and working together to achieve them. Nine sites mentioned these factors in 1996, eleven sites in 1997. The importance of this factor is probably underreported in our survey. Two apparently close-knit teams that we observed in the field did not mention teamwork on the form. The survey asked teams to list *most important* factors. These high-functioning teams may have taken collaboration for granted, and they had more pressing concerns with time and technology.

When we encountered conflicts among team members during interviews and site visits, they often hinged on the perception that one individual had an agenda separate from that of the rest of the team. Although the ability of individuals and agencies to work together is a complex issue beyond the scope of this report, we can say that in The Road Ahead, collaboration was related to the problem of time that we discussed earlier. That is, it was difficult to schedule the kind of regular meetings that are necessary for open communication and problem solving. One poignant comment we encountered during a team interview at the 1996 Seattle conference was that, because of problems of networking, schedules, and location, the national conference provided one of the only opportunities during the year for the entire team—*including teachers in the same building*—to meet as a group.

Among other hindering factors, a lack of buy-in or commitment to the program (usually other non-team teachers in the school) was listed as important by five sites.

Stability

In 1995, at the beginning of The Road Ahead, the NFIE Director of Programs commented to evaluators that the stability of site staffing had been an important factor in previous NFIE grants. The Road Ahead bore this out. In 1997, eight of 19 sites responding to the Year-2 survey listed changes in community partner agencies or particular personnel as important hindering factors. At least one of the sites that did not return the survey had to contend with both school staff and community partner changes. The particulars varied widely: Illness, accident, pregnancy, and job changes removed key people from teams. Policies around travel, staff time, or the use of funds restricted activities. Competing priorities caused partner agencies to reduce or eliminate their participation. We do not have a way to reliably compare sites as to how well they adapted to change, but having top administrators (the building principal or agency director) actively involved in the program was important in shifting resources or staff to accommodate the new situation. Conversely, loss of an involved or sympathetic administrator resulted in reduced support at two sites.

Program Support

Sites were asked in 1996 and 1997 to rate the different types of support provided to them through The Road Ahead. In 1996, the support types listed were the 1995 conference in Washington, D.C.; the mentor; publications sent out by NFIE and ISTE; America Online; and direct advice from NFIE and ISTE staff. In 1997, sites rated the 1996 conference in Seattle, Washington; the mentor; America Online Message Boards; an Internet mail list added in January 1997; and NFIE and ISTE advice.

NFIE

In both years, direct contact with the NFIE office was considered the most valuable form of support. This usually took the form of e-mail or phone conversations with the Program Officer in charge of The Road Ahead, but teams also mentioned site visits by the Director of Programs and other NFIE staff. NFIE was called on to approve changes in plans and budgets, advise on partner relationships, and provide encouragement. Attention from a national organization helped validate the efforts of participants in their communities.

Conferences

The annual conferences were rated as the second most useful form of support. They provided needed technical training, offered teams a chance to share ideas with one another, and, as noted in the previous section, served as a retreat setting in which teams could conduct meetings of their own members with a degree of focus that was not possible during the regular working year.

The final conference took place after the Year-2 survey. In a separate conference evaluation, participants rated the 1997 Seattle meeting as the most satisfying of the

three. Teams and mentors had more input into the conference program in 1997 than in 1995 and 1996, and NFIE responded to evaluations from the first two conference to tailor activities to participants' needs. In particular, team members were offered more opportunities for technical training and practice, more time to report in detail on individual site programs, and a higher profile for community agency concerns in what had been primarily a school-based program.

Mentors; ISTE

In the first year of the program, the mentors were rated more useful than the ISTE staff; in the second year of the program, the ratings were reversed. This is roughly proportional to the amount of contact the mentors and evaluators had during each of the two years. At the beginning of the program, mentors were very active (particularly from September to November 1995) in helping sites revise their original proposals. Sites were required to have revised proposals approved by NFIE prior to receiving their funding. According to interviews with both the mentors and the teams, as sites began to implement their programs, the perceived need for most mentors declined. The challenges tended to involve local conditions that mentors (who were geographically remote) were not aware of or did not understand in detail. At the same time, evaluators began to visit sites and have more contact with the teams, and the needs of the sites revolved more around evaluation and less around planning.

The mentors themselves reported feeling underutilized, in particular at the 1996 conference. NFIE responded to this by assigning much of the program organization at the 1997 conference to teams of mentors and site representatives. Mentors who participated in this activity felt that it allowed them to share their professional skills in a way that had not been possible in their mentoring-at-a-distance role.

Network; publications

The online network consisted of both personal e-mail and discussion areas. The main survey rated only use of the discussion areas. A secondary Online Use Survey in 1997 established that by the end of the program, 14 of the teams had a majority of their members making at least weekly use of e-mail. Fifteen of the team leaders reported daily use of e-mail. Anecdotal comments described a general increase in e-mail use in schools and agencies.

In contrast, the Message Boards and Internet list had declining use during the course of the program. A tally of traffic on the network showed that Message Board use declined from an average of 94 postings per month to 66 postings per month, with four sites accounting for 50% of the traffic in the second year. The Internet list, which came online in January 1997, had an average of only six messages per month, with only 14 of 114 subscribers contributing messages. A separate list for the mentors that was open from September 1995 was more active, but it, too, declined in use from 46 messages per month to 10 message per month, with four of 33 subscribers contributing 50% of the messages by the end of the program.

In interviews and survey comments, sites told us that the discussion areas were most useful when there were particular issues to debate, advice to share, and actions to take: revising the proposals, organizing online student projects, planning the 1997 conference. The discussion areas were not appropriate for sensitive topics such as staffing and budget. These issues were handled by direct e-mail or phone to NFIE. General educational discussions and personal chat made up a large proportion of the traffic during the first year of the program. In interviews, several team members said that it was difficult to locate discussions pertinent to them among all the messages. A similar comment was made about the educational journals and books provided by ISTE during the first year of the program. Although sites appreciated access to these materials, participants felt they needed more time to read, digest, and apply the information.

Time and technology played a role here. America Online turned out to be hard to access for some sites at the beginning of the program. America Online ran out of the Macintosh disks needed by some participants, and some sites had shortages of phone lines and modems. Participants new to e-mail received training in using America Online at the 1995 conference in Washington, D.C., but by the time everyone was physically connected, some of this learning was lost, and the most critical discussions about revising the proposals had already taken place.

Recommendations

- **Let desired learning outcomes guide the use of technology.**

Technology is often installed first, and teachers are left to figure out how to integrate it afterwards. This problem is not limited to education; industry has spent years learning how to achieve real gains in productivity through the use of technology (Gibbs, 1997) The effects of new learning environments on student outcomes may be diverse and not necessarily in line with existing means of assessment (Reed, Spuck, & Bozeman, 1996). In The Road Ahead, some sites emphasized subject-area learning; others put more emphasis on process skills or student motivation. Some sites offered standardized test scores as evidence of success; others felt test scores were not relevant to their programs. At some sites, The Road Ahead activities designed to produce team-defined outcomes (e.g., an understanding of biodiversity) had to compete with district priorities for different results (e.g., increased math and reading scores).

Once fundamental decisions about outcomes have been made, educational stakeholders are in a much better position to select technology and activities. There are computer-assisted instruction (CAI) programs that have been shown to boost testable basic skills, especially for lower-performing students (Kulik, 1994; Van Dusen & Worthen, 1995). The communication and publishing capabilities of networked multimedia computers make it easier for students to undertake independent investigations, construct their own knowledge, and share the results of

their investigations with authentic audiences (ISTE, 1996; Panel on Educational Technology, 1997). This latter application of technology was more typical of The Road Ahead, but CAI programs such as Advantage Learning Systems' Accelerated Reader were also used at some sites.

One student outcome that seems relatively easy to achieve is basic technology skill. Indeed, given access to technology, students readily become technology teachers. Our recommendation is that computer basics such as Web browsing or word processing be acquired "on the job" as students pursue more substantial goals such as research and writing.

- **Allow three to five years for implementation of a program that involves new technology or teaching practices.**

The experience on The Road Ahead is that the first year of a program can easily be consumed by logistics and professional development—planning, installing equipment, learning new procedures, making mistakes, and regrouping. The second year of the program is when teachers develop learning activities and often have to make substantial adjustments and reassess their capabilities and resources. The third year is the first year of full implementation, which for The Road Ahead teams was after the grant ended. Although most teams are able to continue their programs, the profiles offer examples of partnerships and particular activities that had to end with the loss of grant support.

Shorter term programs are obviously worth running. Some sites were able to launch growing, self-sustaining programs with the two years of assistance from The Road Ahead. However, as the principal on one team said, "Readiness is an issue." Some teams entered The Road Ahead with advantages such as existing technology, administrative support, or established partnerships. (In a sense, they had already done their first one or two years.) However, for teams just beginning their innovations or for those that had to cope with unexpected changes, the two years of The Road Ahead did not offer much time to adapt or recover.

The short time frame also presents problems for assessment (Reed, et al., 1996). Even in cases with well-documented improvements in student attitudes or performance, it is difficult to know if the change is durable or replicable without time to repeat and expand the new activities.

- **Balance technology access and professional development.**

No one wants to commit to investing in expensive technology if it will not be used for students' benefit. However, inadequate access to hardware and software guarantees that teachers and students will have difficulty learning and applying the tools. Although this may seem like a classic "chicken-or-the-egg" dilemma, a more useful metaphor is a chain. For any given educational setting at any given time, technology, curriculum, or instruction might be the weak link. For instance, at one middle school, the science teacher on the team felt that her program was hampered by a lack of computers. With the installation of a new computer lab in the second year of The Road Ahead, the most pressing need became working with other science staff in developing learning activities.

- **Enable ongoing teacher-led professional development.**

The effectiveness of teachers helping one another grow professionally, particularly at the school-site level, has been well documented (NFIE, 1996). In The Road Ahead, the site teams used grant resources to acquire training at the three NFIE conferences, at other regional and national conferences, and through special programs such as university courses taught in the school.

Although these special events were the cornerstones of professional development during the grant, we are certain that the key to taking advantage of this sizable investment in training was the total model that involved sharing the learning experiences as a site team, applying the experiences in the school and community, passing the learning on to others, and repeating the shared training (the conference workshops) each year. This is in line with research on effective inservice that supports an ongoing program of training and supported application (Moursund, 1989). It is also backed by the literature on adult learning that emphasizes tailoring learning experiences to adults' levels of experience and need (Knowles, 1970).

The main limitation to professional development reported by site teams was lack of time. Actions at the school, district, or agency level that would support teacher-led professional development include scheduling professional development during work hours, paying for release time and substitutes for teachers to both attend and provide training, stipends or subsidies for after-school training, and sponsoring partnerships with other agencies (museums, libraries, universities) to provide or share professional development. Examples of all these approaches are found within The Road Ahead.

- **Enable student-led technology learning**

The benefits of having students serve as technology teachers of peers and adults include increased motivation, engagement, and responsibility of students; improved student–teacher relationships in a constructivist learning environment; faster spread of technology knowledge; and better technology support for all users (Harper, 1996). The Road Ahead sites are early adopters of this strategy, but some of its instances in the program have been in operation for a long enough period and with sufficient success that they are worthy of further study and replication.

- **Foster students' higher-order thinking skills.**

Throughout the country, educational leaders are calling for increased emphasis on higher-order thinking skills. Thinking and problem solving were goals for a number of the sites in The Road Ahead. Research on the teaching and learning of thinking skills says that appropriate instruction and immersing students in environments that stress higher-order thinking skills can produce significant improvements in student performance. Better than average results can be expected in working with lower achieving students and with at-risk students. However, significant and long-term improvements take significant and long-term interventions (Collins & Mangien, 1992).

Schools that want to take advantage of information technology to help improve higher-order thinking skills of their students will need to:

1. Implement a program of curriculum, instruction, and assessment that has a specific and significant focus on improving higher-order thinking skills.

2. Carry on this program over a period of one to two years before expecting to see significant and lasting results (Moursund, 1996).

- **Enlist additional educational stakeholders.**

Sites with generally expanding programs are doing so with the aid of new school and community partners. Some sites that faced serious challenges, such as the staff changes and loss of a partner school, were able to continue their activities with the help of new or existing partners outside the original grant. New partnerships bring in additional resources and commit a larger number of people to maintenance of the program.

- **Administrators need to be actively involved in planning and maintaining technology integration.**

Because of the numerous issues involved in technology—purchasing, scheduling, staffing, professional development, and so on—benign neglect or moral support is rarely enough to sustain progress in the educational use of technology. Almost half of The Road Ahead sites had to contend with changes of personnel and policy by the end of the program, and these disruptions require attention by administrators with the power to reallocate resources. Teams with involved administrators carried on with their programs despite loss of team members, partner changes, and district funding cuts.

- **Use the experience of The Road Ahead teams to start or continue systemic planning for technology.**

All 22 sites in The Road Ahead now have people in the schools and community with recent practical experience both in implementing educational technology and in establishing school–community partnerships. Furthermore, this experience is not generic, but specific to the community. The bane of educational innovations is the myriad local differences that make a program that is effective in one setting inappropriate in another. However, the veterans of The Road Ahead are well versed in exactly these local conditions, and their hard-earned wisdom should be put to use.

The Road Ahead sites did not attribute success or failure to the presence or absence of technology plans; however, they did note the importance of adequate technology, technology support, teamwork, and coordination with various partners. A systematic planning effort can help identify needs and resources and can help avoid or overcome potential problems in individual programs.

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